

WHAT IS CLAIMED:

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1. A color imaging system providing on-the-fly color interpolation using analog signals to reconstruct colors during sensor readout, the imaging system comprising:

an array of pixel sensor elements;

a color filter including a plurality of color filter components organized in a predefined pattern, the color filter overlaying at least a portion of the array;

a readout control circuit coupled to the array; and

an array controller coupled to the array, wherein the readout circuit and the array controller reconstruct color components for at least a portion of the array while the readout control circuit is reading at least said portion of the array.

2. The system of Claim 1, further comprising:

a comparator circuit adapted to compare an address of a pixel sensor element currently being read by the readout control circuit with a stored list of defective pixel sensor addresses; and

at least one delay element for storing at least one previous analog pixel value read by the readout control circuit, wherein if the address of the current pixel sensor element matches a defective pixel address in the stored list, the readout control circuit reads the previous analog pixel value.

3. The system of Claim 1, wherein the readout control circuit is adapted to read a plurality of pixel sensor elements in parallel.

4. The system of Claim 1, further comprising:

a first analog line storage unit, the first analog line storage unit being adapted to store a first line readout from the array; and

a second analog line storage unit, the second analog line storage unit being adapted to store a third line readout from the array, wherein the readout control circuit averages a second consecutive line readout from the array with the first line readout stored in the first analog line storage unit to produce a first red-green-blue (RGB) triplet, the readout control circuit averaging a fourth

consecutive line readout from the array with the third line readout stored in the second analog line storage unit to produce a second RGB triplet.

5. The system of Claim 4, wherein the analog storage units are capacitors.

6. The system of Claim 1, wherein the readout control circuit is programmable to read a first pixel element in a first mode and to read a second pixel element in a second mode.

7. The system of Claim 1, wherein the pixel sensor elements form a portion of a charge coupled device.

8. The system of Claim 1, wherein the pixel sensor elements form a portion of a complementary metal oxide semiconductor device.

9. The system of Claim 1, further comprising a first programmable gain amplifier adapted to amplify a first color readout signal a first amount and a second programmable gain amplifier adapted to amplify a second color readout signal a second amount.

10. The system of Claim 9, wherein the programmable gain amplifiers are implemented as a separate stage.

11. The system of Claim 9, wherein the programmable gain amplifiers are contained within a pixel circuitry of the array.

12. The system of Claim 9, wherein the programmable gain amplifiers are within a plurality of column buffers.

13. The system of Claim 9, wherein the programmable gain amplifiers have different transfer functions.

14. The system of Claim 1, wherein at least a portion of the pixel sensor elements are active.

15. The system of Claim 1, wherein at least a portion of the pixel sensor elements are passive.

16. The system of Claim 1, wherein at least a first pixel sensor element is associated with a different color filter component than a neighboring pixel sensor element.

17. The system of Claim 1, wherein the predefined pattern is a Bayer color configuration.

18. The system of Claim 1, wherein the predefined pattern comprises the colors of red, blue and green.

19. The system of Claim 1, wherein the predefined pattern comprises the colors of yellow, cyan and magenta.

5 20. The system of Claim 1, further comprising a micro-lenses layer.

21. The system of Claim 1, wherein the readout control circuit and the array controller process a first set of pixel sensor elements and then process a second set of pixel sensor elements, such that the second set of pixel sensor elements overlaps a portion of the first set of pixel sensor elements.

10 22. The system of Claim 1, wherein the readout control circuit and the array controller process a first set of pixel sensor elements and then process a second set of pixel sensor elements, such that the second set of pixel sensor elements does not overlap the first set of pixel sensor elements.

15 23. The system of Claim 1, wherein the readout control circuit and the array controller process a first set of pixel sensor elements, skip a second set of pixel sensor elements and process a third set of pixel sensor elements.

24. The system of Claim 1, wherein the readout control circuit and the array controller only processes a sub-region of the array of pixel sensor elements.

20 25. The system of Claim 1, further comprising a television coupled to said readout control circuit.

26. The system of Claim 1, further comprising a personal computer coupled to said readout control circuit.

27. The system of Claim 1, further comprising a monitor coupled to said readout control circuit.

25 28. The system of Claim 1, further comprising a camera coupled to said readout control circuit.

29. A method of interpolating color components of an array of pixel sensor elements, said method comprising:

30 reading a portion of an array of pixel sensor elements; and

reconstructing color components for at least a portion of the array while  
~~said portion of the array is being read,~~

30. The method of Claim 29, further comprising:

comparing an address of a pixel sensor element currently being read by a readout control circuit with a stored list of defective pixel sensor addresses; and storing at least one previous analog pixel value read by the readout control circuit, wherein if the address of the current pixel sensor element matches a defective pixel address in the stored list, the readout control circuit reads the previous analog pixel value.

31. The method of Claim 29, wherein reconstructing color components is performed in real-time.

32. The method of Claim 29, wherein reconstructing color components is performed in an analog domain.

33. The method of Claim 29, wherein the act of reading includes reading a first set of pixel sensor elements and then reading a second set of pixel sensor elements, such that the second set of pixel sensor elements overlaps a portion of the first set of pixel sensor elements.

34. The method of Claim 29, wherein the act of reading includes reading a first set of pixel sensor elements and then reading a second set of pixel sensor elements, such that the second set of pixel sensor elements does not overlap a portion of the first set of pixel sensor elements.

35. The method of Claim 29, wherein the act of reading includes reading a first set of pixel sensor elements, skipping a second set of pixel sensor elements and reading a third set of pixel sensor elements.

36. The method of Claim 34, further comprising:

summing a plurality of values associated with a plurality of pixel sensor elements associated with a first color to produce a first color component; and summing a plurality of values associated with a plurality of pixel sensor elements associated with a second color to produce a second color component.

37. The method of Claim 29, wherein the act of reading includes reading only a sub-region of the array of pixel sensor elements.

38. ~~A color imager comprising~~

a first light sensor which generates a first analog output signal related to the amount of a first color of light sensed;

a second light sensor which generates a second analog output signal related to the amount of said first color of light sensed; and

5 an interpolation circuit configured to receive said first output signal and said second output signal, wherein said interpolation circuit provides an interpolation signal on the fly based on at least said first analog output signal and said second analog output signal.

10 39. A method of interpolating a color value in the analog domain in real-time, comprising:

receiving a first analog signal corresponding to the output of a first pixel element in an imager, the first pixel element used to sense light intensity of a first color;

15 receiving a second analog signal corresponding to the output of a second pixel element in the imager, the second element spaced from the first pixel element, wherein the second pixel element is used to sense light intensity of the first color; and

20 generating an analog interpolation signal, the analog interpolation signal used to recreate a color value in real-time for a location situated between the first and second pixel elements based on the first analog signal and the second analog signal.

40. The method as defined in Claim 39, further comprising generating an image based on at least the first analog signal, the second analog signal, and the analog interpolation signal.

25 41. The method as defined in Claim 39, further comprising:  
reading a third pixel element located in a line of pixel elements;  
skipping a fourth pixel element located in the line of pixel elements; and  
reading a fifth pixel element located in the line of pixel elements.

30 42. The method as defined in Claim 39, further comprising performing a windowing operation by reading only a subset of pixel elements during a read operation of the imager.

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